

TI 汽车处理器与毫米波雷达芯片 助力ADAS与无人驾驶应用



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总监 - 中国区嵌入式产品系统与应用

2017年8月

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TI 的 ADAS 之路

截止到2016年12月, TDA系列产品累积出货量超过4千5百万片

ADAS SoC Business Unit

Common & Scalable HW Architecture
Software



Front Camera Analytics



Intelligent Park Assist Viewing



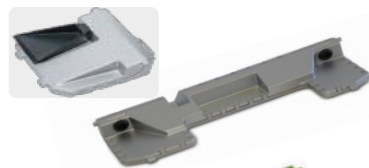
Intelligent Radar



ADAS Fusion

Vision/Open SDK
Kernel Libraries

Tier 1s (>25)

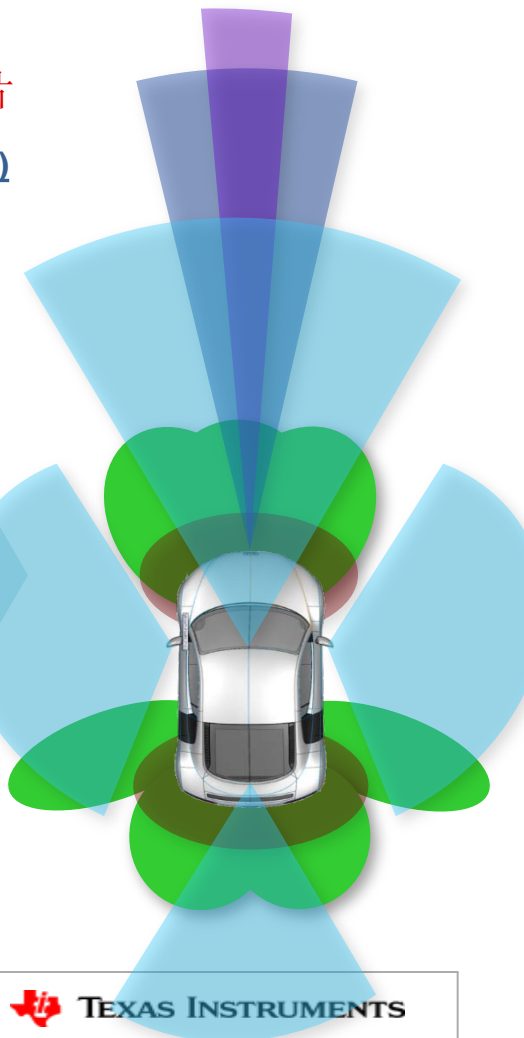


Innovative
ADAS Algorithms

OEMs (>30)

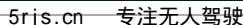
一辆车使用10
片以上ADAS处
理器;

2014年客户基
于TI芯片实现
Level 2



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AUTOMOTIVE DIGITAL COCKPIT



TEXAS INSTRUMENTS

ADAS 应用举例

Core Applications

Front Camera

**Scalable Performance
Low Power
Safety**



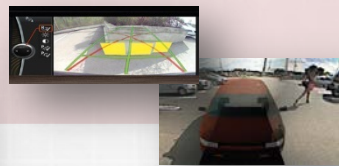
Surround View

**Integrate 3D Graphics
Scalable Analytics
Security**



Rear Camera

**Low Power
Small Footprint
Scalable Analytics**



Radar

**Scalable performance
MCU Integration
Safety**



Sensor Fusion

**High Performance
Safety
Security**



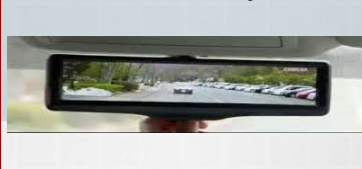
Driver Monitoring

**Small Footprint
ISP Integration Scalable
Analytics**



Mirror Replacement

**Performance
ISP Integration
Scalable Analytics**



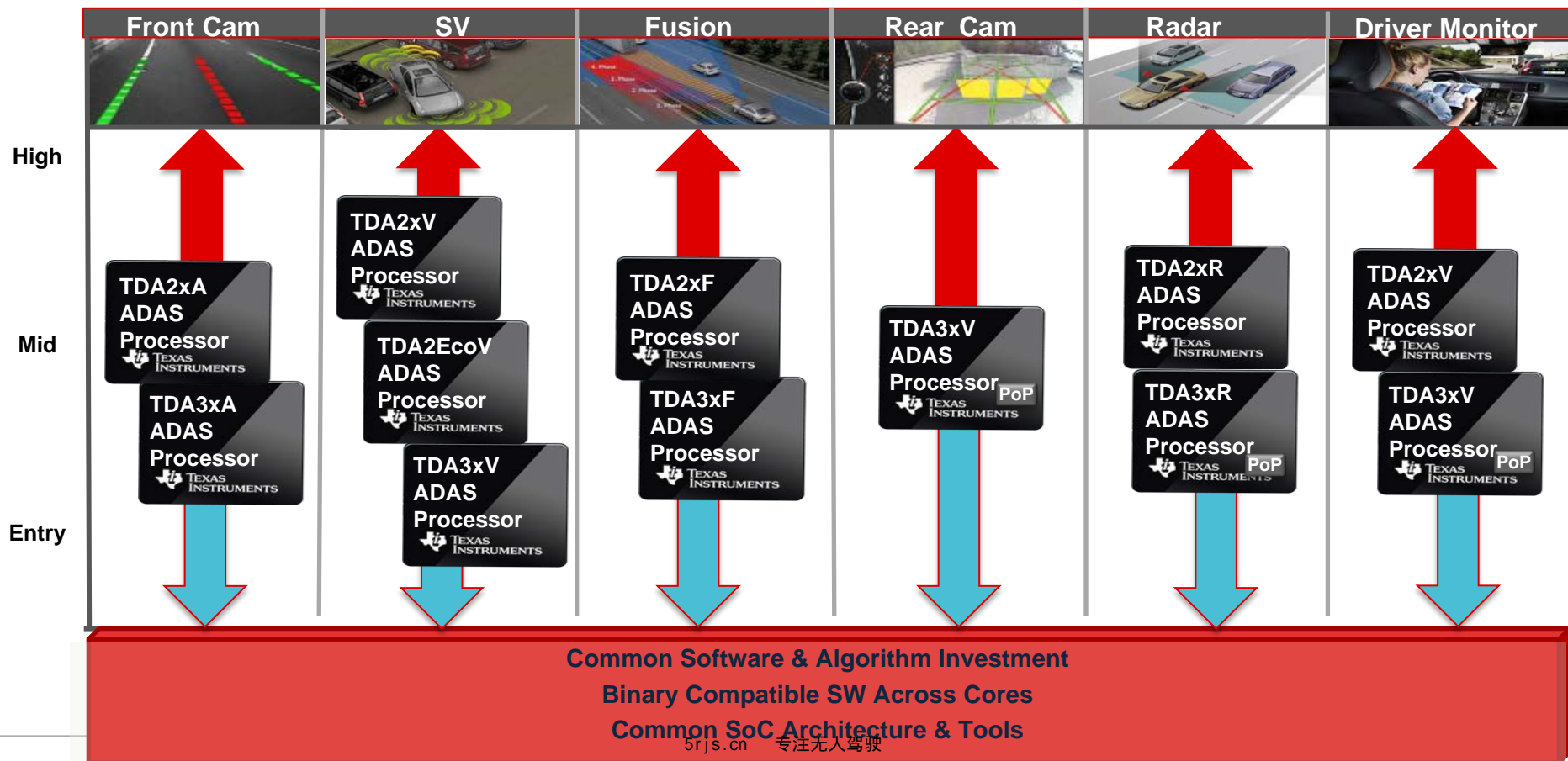
Lidar

Scalable Performance



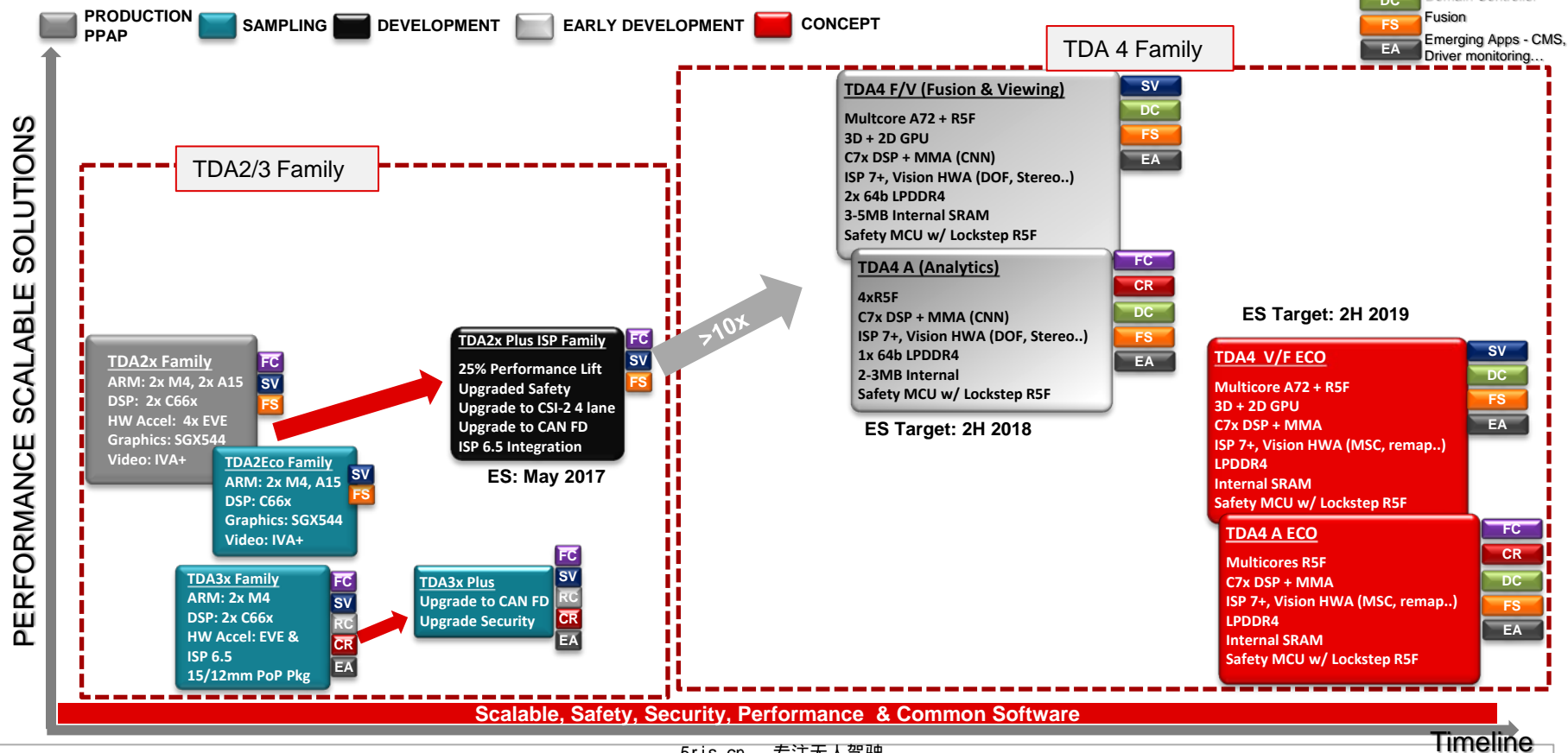
Scalable premium to entry performance solutions.
Fully programmable C66x DSP, ARM cores and Vision Accelerators (EVE).
Software Development Kits and Libraries provide easy portability between platforms.

TDA 家族硬件与软件的可扩展性



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ADAS 处理器产品路标



TDA3x Plus Superset

■ Two DSP Cores: C66x™

- Up to **900 MHz**
- Floating Point Extension

■ Dual ARM Cortex™ M4 Cores

- 200 MHz

■ Vision Accelerator Core: EVE

- Core has an 16MAC per cycle computing engine with up to **800 MHz** (8bit or 16bit)

■ Imaging Sub System with ISP

- Full HW image pipe: DPC, CFA, 3D-NF, RGB-YUV, WDR, LDC etc.
 - 4x 2.0M 30fps @305MHz
 - WDR, HW LDC & Perspective

■ Internal Memory

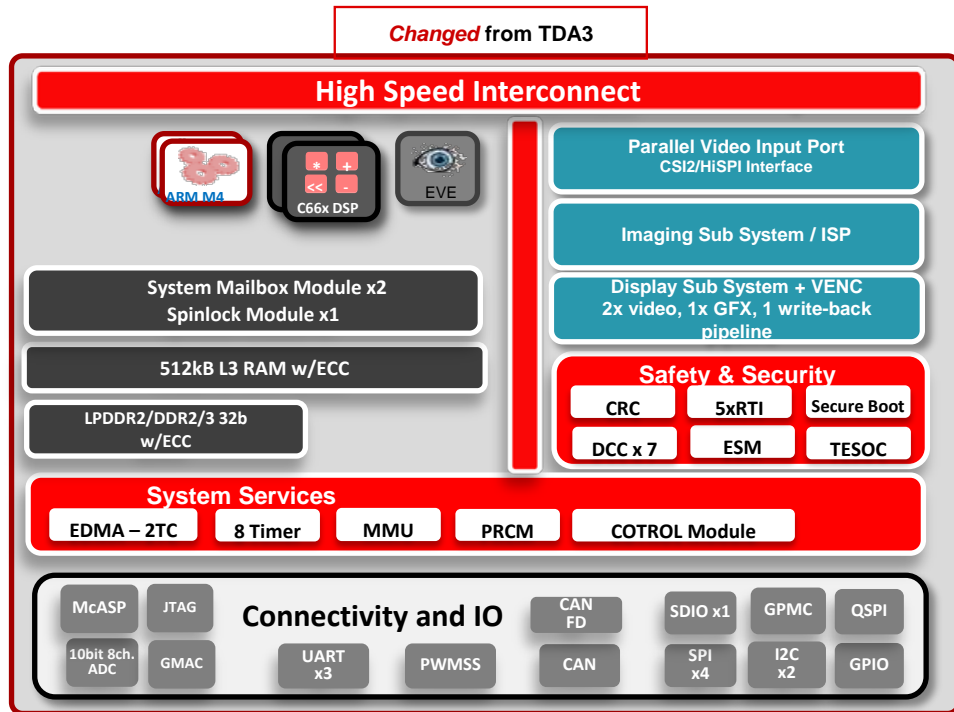
- DSP: 32 KB L1D, 32 KB L1P, unified 256 KB L2 Cache
- ARM : 32 KB L1D, 32 KB L1P, 64KB L2 Cache
- On Chip L3 RAM: 512kB with ECC

■ Peripherals Highlights (1.8/ 3.3V IOs)

- Video Input Ports: Four 8 bit / Two 16 bit ports
- CSI2
- Display system Digital Video Output including SD-DAC
- One EMIF: 32bit wide DDR 2/3 or LPDDR 2 with ECC
- GPMC: general purpose memory controller
- Support for NOR Flash
- Gbit EMAC with AVB support
- **1x CAN FD, 1x CAN**
- 3x UART, 2x I²C, 1x McSPI, Quad SPI, 8x Timers, WDT, GPIO

■ Safety & Security Support

- 7 x Dual Clock Compare (DCC)
- Error Signaling Module (ESM)
- Run-Time BIST
- Memory Protection Firewall (MPF)
- **Secure Boot**



■ Power (~1.0V Core, 1.8/ 3.3V IOs)

- Worst Case @ 125C Tj 2.0W at 745 MHz 2x DSP & 667MHz 1x EVE
- Worst Case @ 125C Tj 1.5W at 500MHz 1x DSP & 1x EVE

■ Package

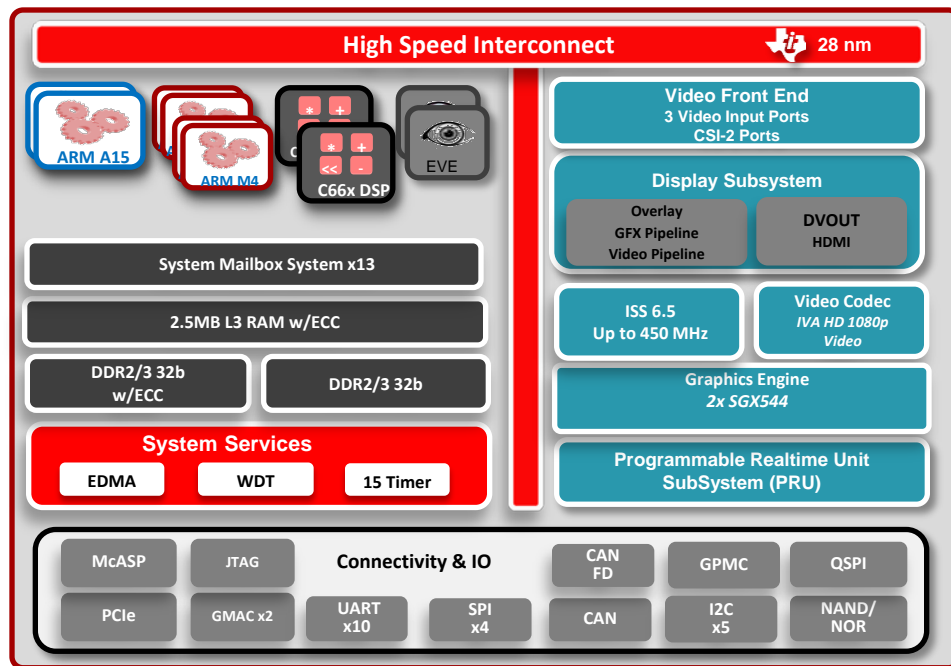
- 15x15mm BGA, 0.65 mm ball pitch
- 12x12mm BGA POP, 0.65 mm ball pitch (limited to 350MHz DSP/EVE)
- Temperature Range: -40C to 125C Tj

TDA2 Plus Family – Superset

Changed from TDA2

PRELIMINARY

- **Two DSP Cores: C66x™**
 - Up to 1 GHz
 - Floating Point Extension
 - L1, L2 ECC
- **Dual ARM Cortex™ A15 Cores**
 - Up to **1.8 GHz** – 12600DMIPS
 - NEON Vector Floating point
- **Two dual ARM Cortex™ M4 Cores**
 - 200 MHz
- **Two Vision Accelerator Cores: EVE**
 - Each core has an 16MAC per cycle computing engine with up to 900 MHz (8bit or 16bit)
- **ISP Subsystem(ISS 6.5)**
 - Compatible with TDA3x
 - Higher performance up to 450 MHz
 - 6x 2.0M 30fps @450MHz or 4x 2.5M 30fps @380MHz
- **Video Codec Accelerator**
 - IVA-HD core running at up to 532MHz
- **Graphics Engine**
 - Dual SGX544 core delivering capability to render up to **665 MHz**
- **Internal Memory**
 - DSPs: each w/ 32 KB L1D, 32 KB L1P, unified 256 KB L2 Cache
 - ARM : 32 KB L1D, 32 KB L1P, combined 2 MB L2 Cache
 - On Chip L3 RAM: 2.5MB with ECC
- **Peripherals Highlights (1.8/ 3.3V IOs)**
 - Up to 10 camera inputs
 - Up to two Video input Ports, each with two 16 bit sub ports
 - CSI-2 Ports, 1 two lane, 1 four lane
 - Display system Digital Video Output
 - Two EMIFs: 2x 32bit wide DDR2/3/L 1333, one with ECC
 - GPMC: general purpose memory controller
 - Support for NOR Flash
 - PRU Subsystem
 - PCIe, 2x Gbit EMAC with AVB support
 - **1x CAN FD, 1x CAN**
 - 10x UART, 5x I²C, 4x McSPI, Quad SPI, McASP, 15x Timers, WDT, GPIO



- **Two different 23x23mm BGA Packages**
 - Version 1: Pin compatible with current TDA2x device with some interface limitations
 - Version 2: Full access to all new interfaces

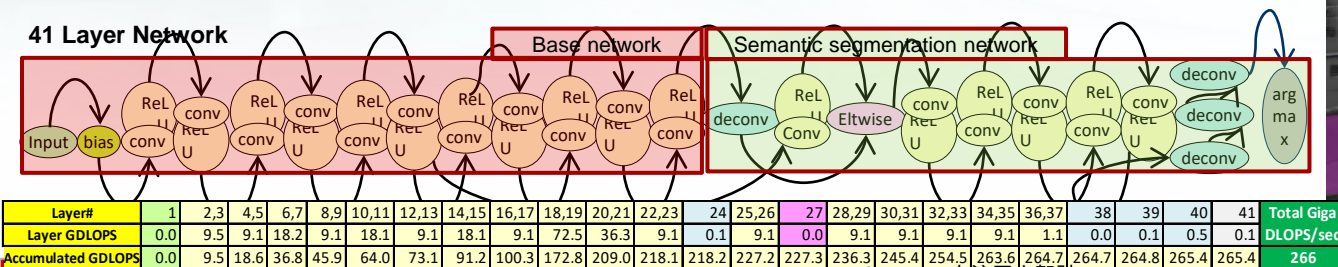
TDA2x 平台上的深度学习实践

Semantic Segmentation 语义识别

- **Semantic Segmentation (or pixel classification)** partitions the image into semantically meaningful parts, and labels each part.
- **TI Deep learning Library (TIDL) & Deep learning network (JSegNet)** accelerates Semantic Segmentation using variety of public/custom networks trained with open source frameworks.
 - Semantic Segmentation Network with 41 Layer. Designed for 8 classes, trained for 5 classes (pedestrian, vehicles, roads, road sign, background)
- **High Efficiency & Low Power implementation**
 - **270 Giga DLOPs/sec** in less than **2.5W** with **2*C66x DSP** and **2*A15** completely free



Your Source for
Inspiration



51js.cn 专注无人驾驶



TEXAS INSTRUMENTS



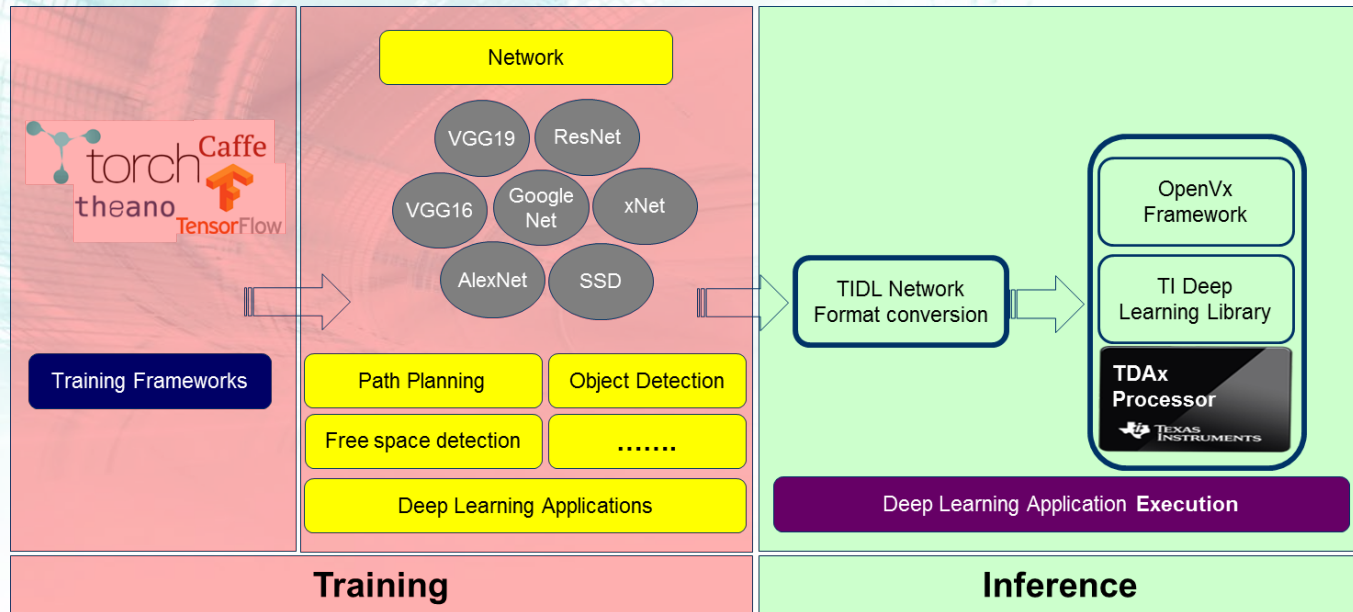
TIDL

- **TI Deep learning Library (TIDL)**

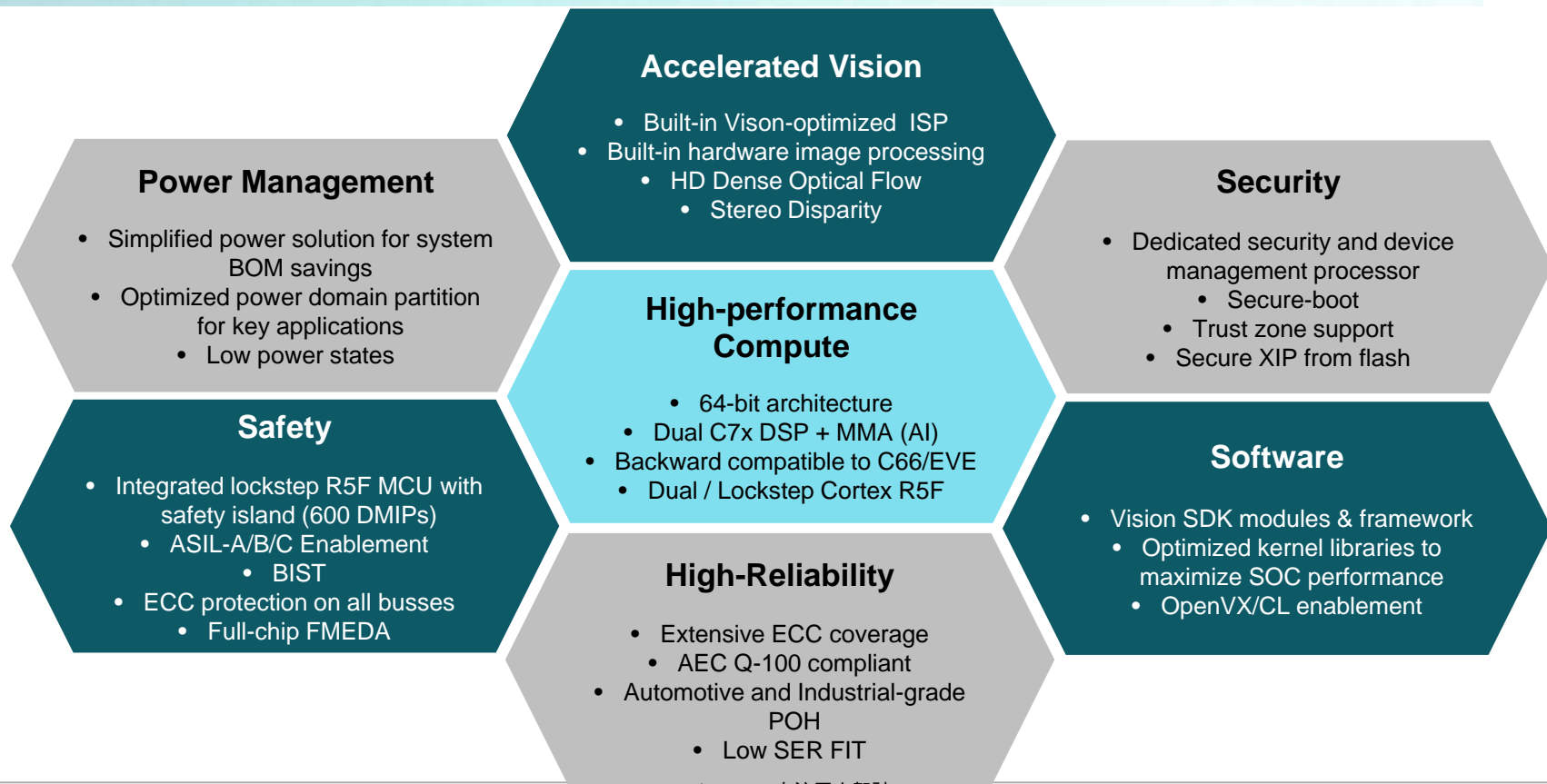
- Abstracts embedded development
- High Efficiency Implementation
- Platform Scalable

- **TI Device Translator Tool**

- Enables development on Open frameworks
- Push Button PC to Embedded porting
- High Efficiency Implementation



平台创新 – TDA4x 家族



Ti 新推出的77GHz毫米波雷达单芯片方案

Auto

Adaptive Cruise Control



Automatic Emergency Brake



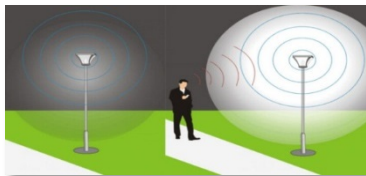
Lane Change Assist



Blind spot detect



Beyond Auto



Gesture Recognition

Infrastructure

Motor Vibration Monitoring

Vital Sign Monitoring

Drones

Industrial Precision Measurement

Occupancy Sensing

Machine Vision – Robots

Factory Automation

Perimeter Security

Building Automation

Structure Vibration Monitoring

日益增长的感测需求



检测物体的距离、速度和角度



适应雨、雾、灰尘、光照和黑暗
等环境条件



穿透塑料、干燥墙壁、玻璃等材料

毫米波是
唯一能够满足
所有这些需求的
传感技术

当今的多芯片毫米波传感器解决方案存在诸多不足

当前挑战

精度

尺寸

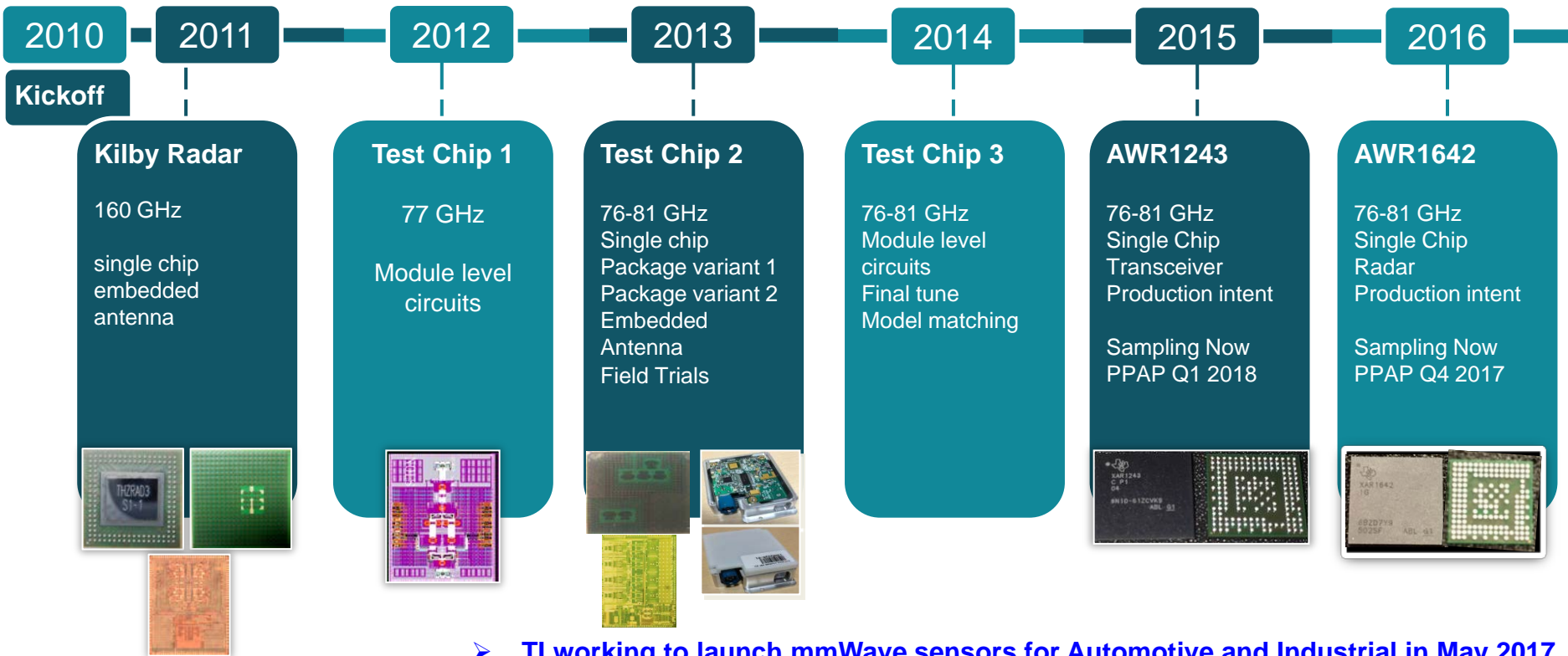
功耗

上市时间

复杂的设计



TI 7年磨一剑 – 推出单芯片CMOS mmWave 方案

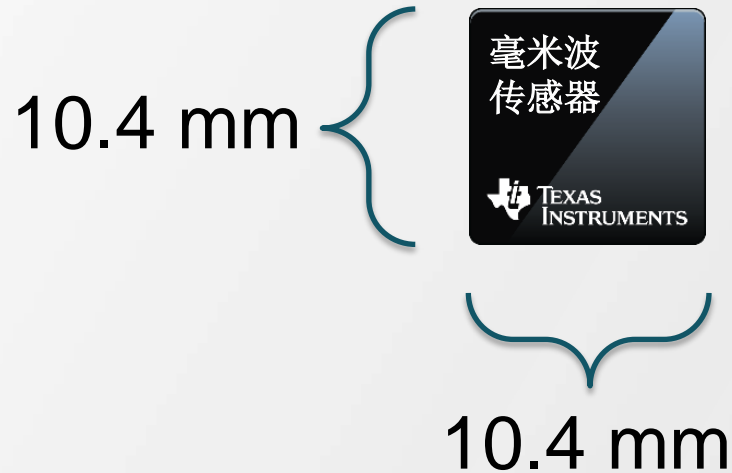


- TI working to launch mmWave sensors for Automotive and Industrial in May 2017
- Re-naming devices from AR to AWR

雷达制成技术的比较

	CMOS	SiGe	GaAs/III-V
Max operating frequency	>100GHz	>100GHz	>100GHz
Logic integration	Very High (>>10X SiGe)	Medium	Low
A2D integration	Yes	No	No
Wafer cost	Lowest	Medium	High
RF Power output	Medium/Low	Medium	High
Power dissipation – RF circuitry	Low	Medium	Medium
Power – data converters	Very Low	Medium	High
Power - logic	Very Low	Medium	High

推出世界上极精确、极小的毫米波76-81GHz传感器



可扩展产品组合



汽车

AWR1243
mmWave Sensors



AWR1443
mmWave Sensors



AWR1642
mmWave Sensors



高性能前段

单芯片集成



工业

IWR1443
mmWave Sensors

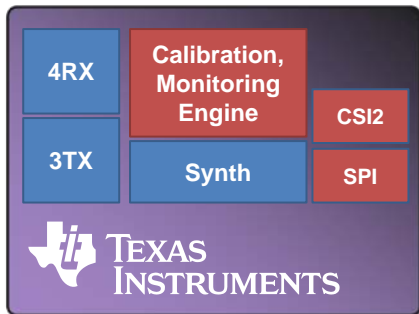


IWR1642
mmWave Sensors



76 – 81 GHz mmWave 雷达芯片

AWR1243

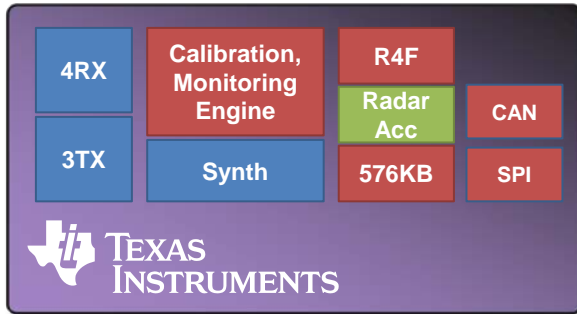


Radar Sensor

• Use Cases

- Imaging Radar Sensor
 - 2x AWR12 (cascade) + External DSP
 - 4x AWR12 (cascade) + External DSP

AWR1443

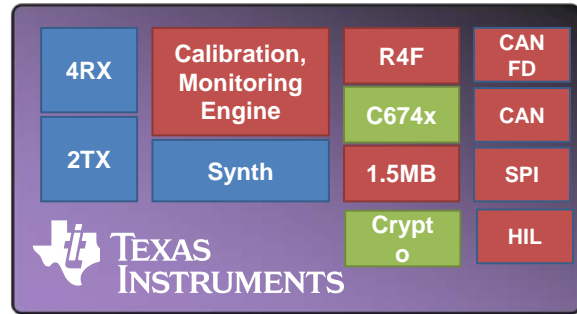


Radar Sensor + HW Accelerator

• Use Cases

- Entry-level Single-chip Radar
 - Proximity warning, Blind spot

AWR1642



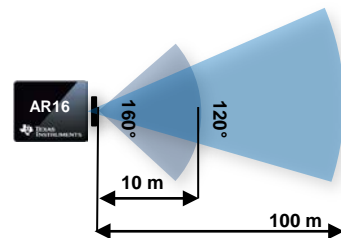
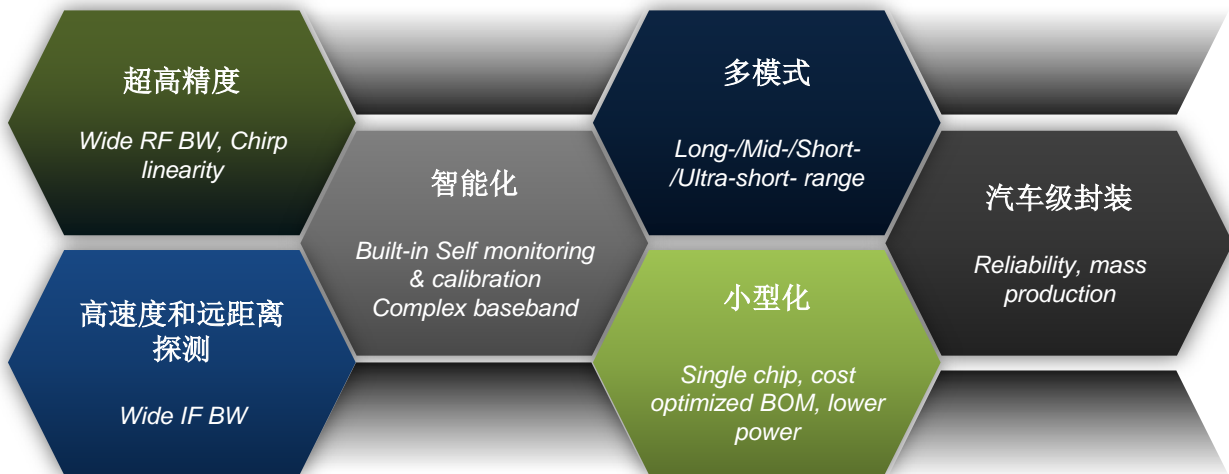
Radar Sensor + DSP

• Use Cases

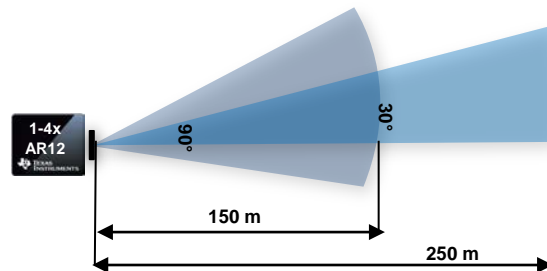
- USRR Single Chip Radar
 - 160 Degree, 40m
- SRR Single chip Radar
 - 120m Cross traffic Alert

目前业界最高精度的CMOS雷达芯片

助力Level 2 以及更高级别自动驾驶



- < 5cm range resolution
- 0.01% chirp linearity



- < 1° angular resolution
- 300km/hr max relative velocity

汽车雷达传感器



汽车雷达传感器

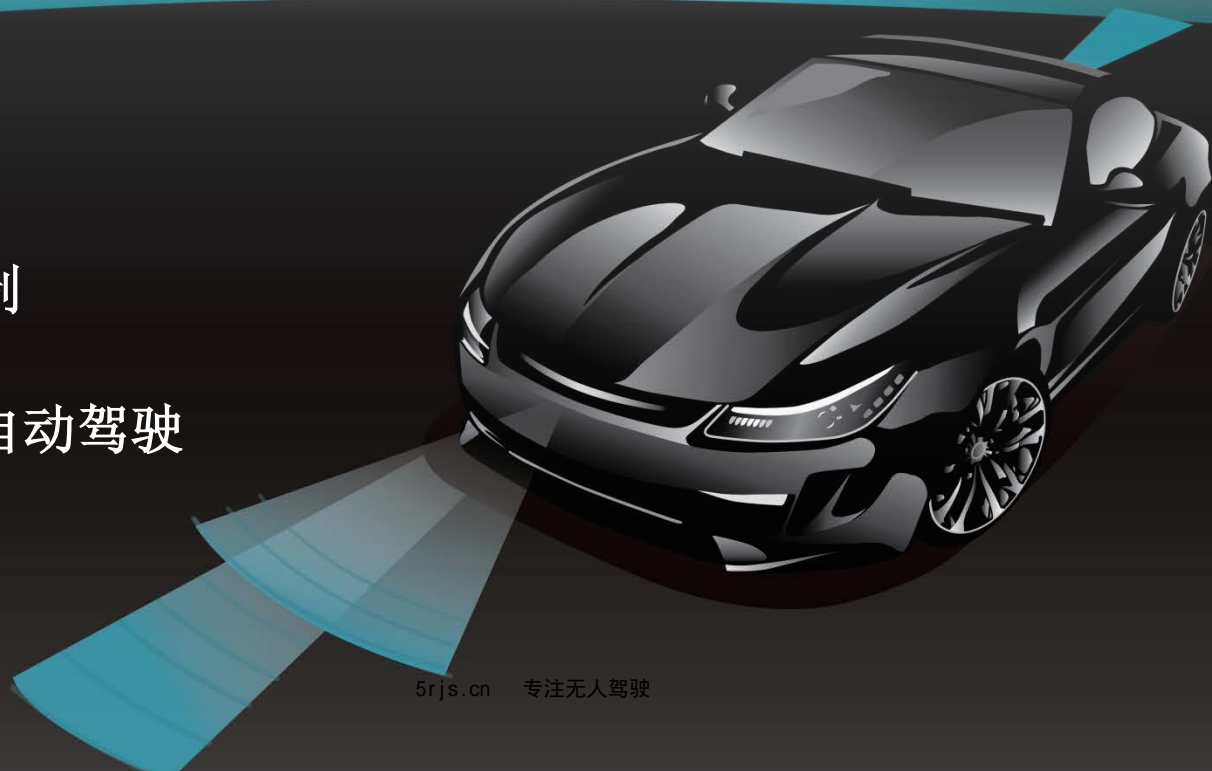
中长程雷达



紧急制动

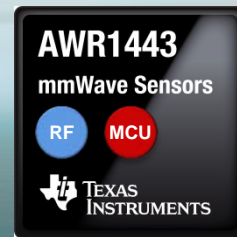
自适应巡航控制

高速公路高度自动驾驶



汽车雷达传感器

接近感测



乘员检测

车身传感器

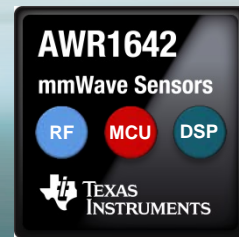
驾驶室内手势识别

驾驶员监控



汽车雷达传感器

超短和短程雷达



盲点

防后方碰撞/警告

车道变更辅助

行人/自行车检测

防碰撞

路口交通警报

360度视角

停车辅助



汽车雷达传感器

动态多模式操作

从用餐切换到高速行驶到慢速机动
和停车场景的传感器



汽车雷达系列



- 中远程雷达
- 接近感测
- 超短和短程雷达



现已推出

完整的毫米波产品组合与开发工具



毫米波
Studio



毫米波
培训



通用
软件



参考
设计

TI Designs

开发
工具



中国市场光明的前景

2016年，我国汽车产销突破2800万辆，连续8年位居全球第一，其中中国品牌汽车销量占比50%左右。

“到2020年，汽车DA（驾驶辅助）、PA（部分自动驾驶）、CA（有条件自动驾驶）系统新车装配率超过50%，网联式驾驶辅助系统装配率达到10%，满足智慧交通城市建设需求。到2025年，汽车DA、PA、CA新车装配率达80%，其中PA、CA级新车装配率达25%，高度和完全自动驾驶汽车开始进入市场。”

工信部联装〔2017〕53号
(2017年4月6号)



Thank You